ALBERTA FOREST GENETIC RESOURCES COUNCIL

2006 Annual Report

Message from the Chair

This seventh annual report of the Alberta Forest Genetic Resources Council represents a change in our reporting practice. Members wanted a report that was relevant to activities undertaken during the most recent field season and to the calendar year just past, and this is why you are now receiving our report at this time of the year. I look forward to your feedback on the value of this change in giving you a timely and relevant annual report.

Recent months have seen Council make excellent progress on three major initiatives identified as immediate priorities by members. The first involved external communications, not only for Council but also for the forestry sector as a whole. Next came advocacy in the area of forest productivity, with the objective of integrating forest genetic information into growth-and-yield modeling and timber supply analysis. The third area involved identification of and advocacy for tree genetics research gaps and priorities along with future opportunities.

The expertise and dedication of Council members have also resulted in a number of other issues moving forward. The conservation of forest genetic resources has been addressed with completion and endorsement of a gene conservation plan. Other initiatives have included protocols around access and benefit sharing of genetic resources, criteria & indicators for genetic diversity, and the review of tree improvement standards in Alberta. Council has also turned its attention to climate change. Given the magnitude of potential change and its impacts on our forest genetic resources, Council will continue to treat this issue as a priority for the foreseeable future.

Doug Sklar, Narinder Dhir, Bruce Dancik, Pat Wearmouth, Chris Shank and Steve Luchkow ended their terms on Council, and we are indebted for the contributions they made during their time with us. We were glad to welcome Leonard Barnhardt, Andreas Hamann, Bruce Macmillan and Scott Milligan who joined us this past year, as well as our newest members Dave Beck and John Stadt who are coming on board in 2007.

Cliff Smith, Chair
Alberta Forest Genetic Resources Council

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Recent months have seen Council make excellent progress on three major initiatives identified as immediate priorities by members.

Tree Improvement

Tree improvement programs in the province involve two deciduous species and six coniferous species native to Alberta. All programs are based on traditional plant breeding methods with no genetic modification (GM) involved. Conservation of genetic diversity and maintenance of adaptability to natural environments are primary objectives of all native species programs. The challenge of changing climate underscores the importance of maintaining high levels of genetic diversity in these breeding programs.

Most programs involve cooperative arrangements either among companies, or between Alberta Sustainable Resource Development and single or multiple companies. Several programs are also being developed by the Department or by individual companies.

The first coniferous programs were initiated in 1976, and new programs have been continuously added. Some mature orchards have produced considerable amounts of seed for operational deployment. A broad genetic base has been accumulated, and thousands of wild genotypes have been preserved by grafting in *ex situ* (away from natural habitat) reserves. In conjunction with the *Gene Conservation Plan for Native Trees of Alberta*, a system of *in situ* (within natural habitat) reserves is also being initiated for all species involved in breeding programs.

Increased wood production through faster growth rates is a primary objective of the programs, although some conifer programs are designed to alleviate seed shortages. Researchers are also selecting for disease resistance, particularly in poplar programs.

Orchards of lodgepole pine, white spruce, black spruce, jack pine, douglas-fir and western larch have been established. To date, more than 1,100 kg of seed have been produced, and over 12,000 ha have been planted with improved conifer seed. Progeny tests associated with the older programs are yielding fast-growing healthy individuals for inclusion in the next generation's breeding and orchard populations.

Coniferous programs are summarized below.

Several forest products companies are developing programs in aspen and aspen hybrids, balsam poplar, hybrid poplars and birch. The first aspen cooperative program was formally initiated in 1992 by a group of companies. Priorities for hardwood programs include breeding and testing for adaptation, growth rate, disease resistance and wood quality traits. Thousands of poplar and aspen genotypes have been selected, and more than 100 tests have been established. Deployment on private land began in 2000; testing is currently under way for future deployment on public land.

Provincial genetics policy (*Standards for Tree Improvement in Alberta*)[+], enacted in 2003 and revised in 2005, encourages investment in tree improvement activities. The standards establish a framework for program development and accrual of benefits, while ensuring that genetic diversity, adaptation and conservation objectives are met.

	# of programs	parents in programs	parents under test	genotypes in orchards	trees in orchards	total seed produced (kg)	hectares planted
Douglas-fir	1	45	0	39	121	0	0
Western larch	1	27	0	18	80	0	0
Jack pine	1	70	0	56	434	0	0
Lodgepole pine	7	1,938	1,633	642	10,204	230.1	9051
Black spruce	3	266	179	221	3,268	0.7	0
White spruce	9	1,289	932	823	8,743	916.9	3,537
Grand Total	**22**	**3,635**	**2,744**	**1,799**	**22,850**	**1147.7**	**12,588**

[+] *http://www.abtreegene.com/images/STIA.pdf*

Conservation of genetic diversity and maintenance of adaptability are primary objectives of all native species programs.

Gene Conservation Plan

The new (2006) *Gene Conservation Plan for Native Trees of Alberta* identifies and describes Alberta's native tree species and outlines a methodology for identifying and protecting populations of these species to ensure continued forest health and evolutionary resilience.

The conservation plan is important to Alberta because genes represent the potential of any organism, population or species to adapt to the environment. For Alberta's 28 native tree species, environmental challenges include fragmentation and isolation of populations due to economic development and land-use conversion, climate change and increasing pressures from pests and diseases. These conditions have the potential to erode the genetic variation required for evolution and continued forest productivity and health. The conservation plan and related activities will identify measures to protect this variation for future economic development, scientific study and continued forest evolution and health.

Implementation will occur over the coming decade or so. A formal protocol will help establish conservation priorities by species. The initial conservation emphasis will be on two species for which large-scale planting of traditionally-bred improved trees is in progress (lodgepole pine and white spruce), and two species that are particularly vulnerable to disease, wildfire and climate warming (limber pine and whitebark pine). Efforts to fill gaps in the network of protected populations will be concentrated on Alberta's public lands. Complementary efforts will be undertaken where candidate populations for protection are outside provincial public lands.

The Parks and Protected Areas Division of Alberta Tourism, Parks, Recreation and Culture and the Forestry Division of Alberta Sustainable Resource Development have an agreement to develop and coordinate implementation of the plan with guidance from the Alberta Forest Genetic Resources Council and in concert with forest companies. The major part of the plan deals with establishment of *in situ* (within natural habitat) reserves for commercial and non-commercial species. Companies involved in tree improvement have the primary responsibility for establishment and maintenance of reserves for species in their tree-improvement programs. It is envisioned that many of the reserves can be established within the existing Parks and Protected Areas network. However, there will be a requirement for reserves to be established on other public lands for some species and local populations. Coordination between the working group on native tree gene conservation and local contacts and land managers will be crucial for implementation.

Implementation of the plan commences in 2007 with establishment of *in situ* reserves following gap analysis on a prioritized species basis. An *ex situ* (away from natural habitat) component of the conservation plan is under development for seed, pollen and plant materials maintained in archives, clone banks and field plantings.

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Forest Productivity

Council teamed up with Foothills Growth and Yield Association in a joint project to promote the incorporation of forest genetic information into growth and yield modeling and timber supply analysis.

With the support of Foothills Model Forest Council made a successful application to the Forest Resource Improvement Association of Alberta's Open Funds program, resulting in funding for a major Post-harvest Stand Development conference.

The conference was held in Edmonton on January 31 and February 1, 2006, and was attended by over 150 delegates from across North America and offshore, including leaders and experts from academia, government and industry. Our objectives were to:

- Share and integrate information concerning the effective management of forest stands regenerated after harvesting in Alberta;
- Determine delivery options for the integration of genetic, growth and yield, silvicultural and forest health information;
- Achieve understanding by forest managers of how this information can be applied in policy and practice;
- Identify information gaps and associated research requirements for growth and yield modeling.

The delegates shared information and ideas and listened to 25 speakers in plenary and concurrent sessions. The speakers participated in nine break-out groups focused on the fourth conference objective noted above. More than 40 issues and 44 recommendations were identified for consideration. A final panel of seven experts reflected on the outcomes of the breakout groups as well as their own perspectives on the major themes of the conference.

Delegates explored ideas that could inform Alberta forest policy and suggest action plans appropriate for the Foothills Growth and Yield Association, the Alberta Forest Genetic Resources Council, their corporate members and potentially other participating agencies.

The conference co-chairs concluded that improved information and knowledge are indeed required for the management of stands regenerated after harvesting. Further action is now required in the areas of program alignment, integration of inter-disciplinary information, education, application and research. As a follow-up to the conference, three facilitated dialogues will take place to focus on next steps in these areas. Proceedings and other information can be found on Council's website, www.abtreegene.com.

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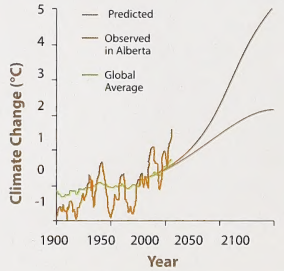
Climate Change

In 2005 and 2006 the Alberta Forest Genetic Resources Council conducted an in-depth review of genetic resource management issues related to climate change, drafted a framework document for climate change planning, and adopted the following statements of principle:

- Council accepts that climate has changed in recent decades and scientific evidence indicates this trend will continue. Early impacts on forest ecosystems are now being detected. Therefore, Council believes that the risk of status-quo forest management exceeds the risk of making changes to management practices.
- Council's primary concerns are loss of forest productivity due to inadequate adaptation of current commercial tree species, loss of genetic resources due to localized extinction of populations, and impacts on forest ecosystems such as increased pest and disease outbreaks, extreme climate events, and increased forest fire frequency and intensity.
- Because of the long-term nature of forestry, Council believes that adaptation strategies for forest resource management should be implemented as soon as possible to mitigate anticipated impacts of climate change. Council recommends the use of research results and pilot projects to adapt the current reforestation practices to climate-informed resource management strategies.

Climate change over the last half century has increased mean annual temperatures by almost 1°C across Alberta. This trend is expected to continue, resulting in warming by about 2 or 3°C over the next 50 years. Regional and seasonal patterns of precipitation may also change substantially. Such changes create new challenges for forest management, and forest-based communities which rely both economically and socially on the resource.

Even though warming by 2-3°C does not sound very threatening, the effect on forests could be substantial. The figure on the next page shows how the tree and plant communities of today might be located in order to be well adapted to the predicted climates of the 2020s, 2050s and 2080s. The forests we see today are the result of thousands of years of natural evolution and ecological processes. The anticipated change in climate may be too rapid and severe for successful adaptation by our current forest trees.

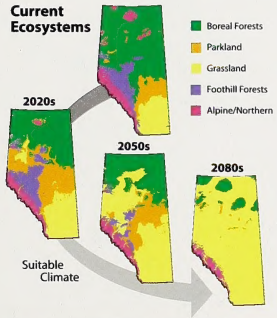


Data from NASA and AHCCD http://tinyurl.com/epy8o

Council believes that the risk of status-quo forest management exceeds the risk of making changes to management practices.

Tree populations can naturally "move" by way of seed dispersal to more suitable regions and climates – but these are slow processes. Careful and well-planned tree breeding and movement of planting stock (further north and/or to higher elevations) during reforestation activities can assist in population adaptation.

Well established and carefully regulated tree-breeding work in Alberta is already providing data and seedlings to help forest managers prepare for these anticipated changes. Genetic field testing of planting stock has been done in Alberta for the past 25 years, which has allowed us to generate some preliminary information to guide these activities. Further tests specifically designed to answer these questions are under development.



Methodology described in Ecology (2006) 87: 2773-2786 (http://tinyurl.com/nvk8p)

Researchers in government, academia and industry are working to better understand the response of forest trees and ecosystems to possible future climate change scenarios. Some species are likely to benefit from warmer climates with increased growth rates and an expanded range, whereas other species could disappear from some regions. We believe knowledge is key to making the right decisions about forest management today and in the future.

Council will advise the government of Alberta on potential adaptation strategies, as well as on research and resource needs. Council will also develop an educational plan for the public and inform other researchers and decision-makers about climate change and its effects on genetic adaptation. It will also work to promote development of adaptation strategies with non-governmental sectors and industry.

We believe knowledge is key to making the right decisions about forest management today and in the future.

Research: Gap Analysis

A study completed by Council partners, with support from the Alberta Forestry Research Institute, helped pinpoint some forest genetics research needs in the province.

Sixty-three surveys investigating research gaps in forest genetics were completed, categorized and analyzed to better understand the needs of industry, government and academia in Alberta. The survey identified not only gaps in current research, but also gaps in the infrastructure and personnel required to conduct these research activities.

Respondents indicated that there is a lack of basic knowledge about the genetics of tree species found in Alberta. By gaining a better understanding of these trees' genetic diversity and how performance is linked to site, fundamental questions would be answered that could directly impact deployment strategies, climate change considerations and, ultimately, government policy.

Three areas of work were of priority interest to those who are users of research. They were breeding program expansion, genecological work including basic research, molecular tools and nursery needs, and deployment issues related to both material and policy.

Those who produce research, meanwhile, showed broad levels of support for a more comprehensive range of interests and needs. Categorized by tree type, 56 per cent of the desired projects were related to poplar and 24 per cent to conifer. Most of the remaining projects were not tied to specific species, though one project related to willows.

Two categories of human resources needs and priorities were identified. One related to liaison-type positions that ensure effective knowledge transfer between communities, putting knowledge into practice, and the teaching of undergraduates. The second had to do with additional researchers needed to conduct the work and/or statisticians to analyze the data. The need for quantitative and molecular genetics specialists was specifically identified.

Although only a snap-shot, this survey provided a significant amount of information to assist with determination of next steps and research priorities in the forest genetics community in Alberta.

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Research: Council Priorities

During the period under review, Council has identified and priorized some key research needs anticipated by various stakeholders.

Foundations for the discussion included the research gap analysis (see page 7) and other studies. One stimulus for the work was Council's belief that anticipated climate and environmental changes could invalidate traditional methods of priorizing research needs. Forest policy and practice, and the supporting research, have tended to follow a path of risk avoidance. New pressures require us to lean more toward a scientific assessment of the risks *and* benefits associated with seed transfer and the use of hybrids or exotics. Other issues to be assessed in this way include levels of genetic diversity in deployment populations, selection of fast growing, insect- and stress-resistant forest trees, guidelines for deployment of planting material in the landscape, and guidelines for conservation of forest genetic resources.

Following are the research areas advocated by Council to support the development of science-based policies and practices.

- Research supporting the development of seed transfer guidelines. Transfer rules should be based on knowledge of plant-climate relationships. This research may utilize experimental and modeling approaches.
- Research supporting the development of guidelines for responsible use of exotics, hybrids and out-of-range deployments. This should include consideration of uncertain future climates. Possible approaches may include long-term field testing, ecological niche modeling of risk of invasion, experimental and empirical research on gene flow and fitness.
- Research supporting the development of guidelines for resourceful use of superior genotypes from tree improvement programs. This includes investigating the indirect effects on adaptive traits when selecting for superior growth and the feasibility of selecting for resistance to environmental stresses, including those expected under climate change scenarios.

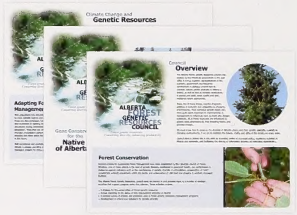
- Research supporting the development of guidelines for managing genetic diversity at stand and landscape scales. Research should have an emphasis on commercially important species. Possible approaches may include risk-gain modeling of various deployment patterns and genetic diversity levels in populations.

New pressures require us to lean more toward a scientific assessment of the risks *and* benefits associated with seed transfer and the use of hybrids or exotics.

Outreach and Education

The year ending March 31, 2007, is the last in Council's three-year strategy to create some basic awareness and information resources for our stakeholders in media, public, industry and government circles. Generous support given specifically for this task (see box) has allowed us to:

- Launch and provide monthly updates for a comprehensive website (www.abtreegene.com);
- Prepare and distribute this annual report;
- Prepare a fact sheet on Climate Change – one of five fact sheets now available for download on our website;
- Print two Council-related articles in a forestry trade magazine;
- Create a slide presentation and speech for a Climate Change panel session at the Alberta Forest Products Association annual meeting and conference;
- Provide information materials to the Minister of Alberta Sustainable Resource Development and potential partners such as the Alberta Forestry Research Institute.



Looking forward, we can see that genetic conservation, forest productivity, climate change and mountain pine beetle are going to be of critical importance to Albertans and their forests. We are planning a second three-year strategy that will explain the role Council might play in all these issues, while at the same time engaging young students and teachers in the practical realities of what they must know and do to ensure sustainable forests.

Our sincere thanks to our funding partners of the past three years:

Ainsworth Lumber Co. Ltd.

Alberta-Pacific Forest Industries Inc.

Alberta Sustainable Resource Development

Canadian Forest Products Ltd.

Canadian Forest Service

Daishowa-Marubeni International Ltd.

Footner Forest Products Ltd.

Manning Diversified Forest Products Ltd.

Northland Forest Products Ltd.

Poplar Council of Canada

Tolko Industries Ltd.

University of Alberta (in kind)

Weyerhaeuser Company Ltd.

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Partner Activity: Genetics and Reclamation

Council partners are involved in many individual genetics-related projects; one example is Alberta-Pacific Forest Industries Inc.'s research in support of improved well-site reclamation as well as forest sustainability.

The overall goal of the work, supported by a number of energy and forestry companies and the University of Alberta, is to develop best practices for reclamation of certain well-sites on forested lands in northeast Alberta. The results may also be applicable to other oilfield disturbances elsewhere in the province.

The project will determine if replanting is required at all disturbed sites and if so, what tree species would be most suitable. Variable site, moisture and climate can produce stock selection challenges that have not previously been addressed for boreal forest reclamation.

Specific challenges include establishment of planted trees prior to site invasion by aggressive herbaceous species; logistics related to planting small but highly dispersed and highly variable sites; and seed collection and propagation systems suited to energy companies that require relatively small numbers of trees from a number of different seed zones.

Species used in the trials have included trembling aspen, paper birch, white spruce and jack pine plugs. Unrooted balsam poplar cuttings were also tested in these trials. While statistical analyses of results have yet to be completed, preliminary observations indicate that pine and birch appear to be the most versatile in terms of survival and vigour. Balsam poplar also produces vigourous growth under most site conditions although establishment is somewhat more difficult due to the additional preparation and handling required to keep unrooted cuttings viable.

A best practices manual including ecologically and economically sound well-site construction and reclamation protocols will be produced in 2008, at the conclusion of the study.

Reclamation of these sites represents an enormous opportunity for oil & gas and forestry to work together to find the best solutions when replanting these challenging sites. Industry partners include Canadian Natural Resources Ltd., ConocoPhillips, Devon Canada, EnCana, JACOS, Nexen and OPTI Canada.

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ALBERTA FOREST GENETIC RESOURCES COUNCIL

Secretariat:

402 Meadowview Terrace
Sherwood Park, Alberta T8H 1X7
Phone: (780) 449-5626
Fax: (780) 449-5626
Website: www.abtreegene.com
E-mail: afgrc@shaw.ca

Council Membership

Scientific Sector:	Dr. Andreas Hamann, Dr. Ken Mallett, Dr. John Spence
Biological Sector:	Chris Shank
Industry Sector:	Steve Luchkow, Dr. Sally John, Bruce Macmillan, Dr. Barb Thomas
Government Sector:	Leonard Barnhardt, Dr. Ken Greenway, Scott Milligan
Chair:	Cliff Smith

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